LUBRICATION

Published by THE TEXAS COMPANY

All communications should be addressed to

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17 Battery Place, New York

VOL. III MARCH, 1916 No. 5

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Those who fail to receive LUBRICATION promptly, will please notify us at once and will confer a favor by promptly reporting change of address.

EDITORIAL

Beginning on the next page is an article on the Snow Oil Engine. This article was written by the manufacturer.

We would call your attention to the importance which is placed on lubrication. You will find this note sounded throughout all written matter descriptive of Oil Engines, such as Diesels and other units consuming heavy distillates. The manufacturers have come to a keen realization of the importance of the factor of lubrication as it affects the way in which their product lives up to its guarantees. The user of this type of engine will do well to give the same careful consideration to the choice of the lubricant.

We trust that the reader will appreciate the full significance of the caption appearing under the illustration on page number three.

In passing, we would say that this particular manufacturer has good reason to associate Texaco Ursa Oil with his engine. It has shown some unusual performances in the reduction of wear and the prevention of carbon difficulties.

This manufacturer also builds the Snow Gas Engine on which Texaco Ursa Oil has demonstrated its quality and suitability.

A case in point was shown by the result of a comparative test on a Snow Gas Engine in a large power plant in Texas, a careful report of which has been prepared in pamphlet form.

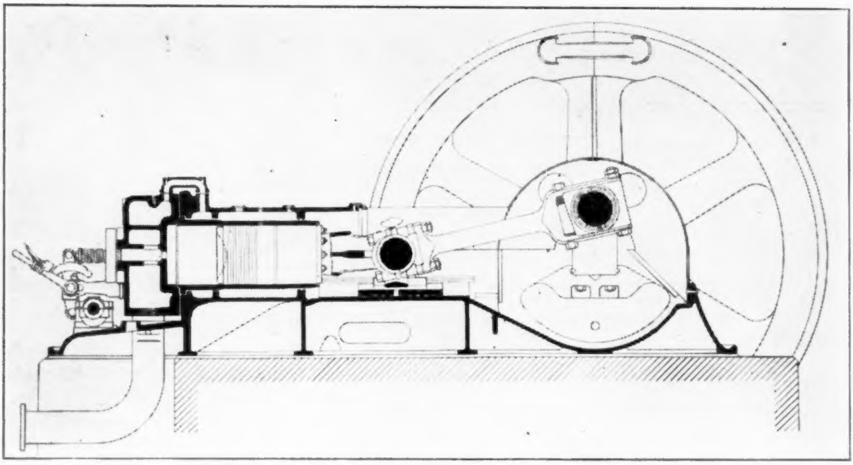
This report brings out many interesting points and we are more than pleased to send a copy of same to anyone requesting it from the Editorial Office.

A post card will bring it.

Apropos to the "COLD TEST" article appearing in this issue: A manufacturer of shock absorbers using an oil cushion recently ran a cold test on oils. It was of paramount importance that the oil should not congeal. His test was as simple as it was efficacious. He bought five-gallon cans of the leading oils, put them on his roof exposed to snow and weather. As they congealed they were eliminated. Finally the only one left was Texaco Motor Oil.

Not only did it surpass the rest, but it remained fluid and could be poured at a temperature at which all the others remained in the can held upside-down.

Our announcements regarding Texaco Crater Compound are attracting considerable attention—more than that, the "leads" secured through them are consistently producing orders. This proves one thing. There is a need for a heavy lubricant of this kind—and "Crater" meets the need.



Section of Four-Cycle Snow Oil Engine

THE SNOW OIL ENGINE—ITS DESIGN AND APPLICATION

The Snow Oil Engine is of the horizontal as opposed to the vertical type—hence accesibility of all parts from one floor level. The valve gear and camshaft, and in many cases the governor and fuel pumps, on the vertical engine can only be inspected by climbing to an elevated platform. This not only makes the operation of the engine more difficult for the engineer in charge, but in case of carelessness on his part subjects these important factors to neglect. In the case of large installations, more labor must be provided to insure proper attention, which is quite a serious consideration, especially in this country where wages are comparatively high. In witness of this fact, many builders of reciprocating steam and gas engines have adopted the horizontal type. Further advantages of the horizontal engine consist of the lack of vibration, due to the center of gravity of the engine being lowered and the ease with which the piston may be removed, a process in the Snow engine consisting simply of detaching the connecting rod at the wristpin and swinging it around the crankpin and out of the way, when the piston can be withdrawn through the crank pit. Note the operations necessary to accomplish this result in the vertical engine:

1—The water connections to the cylinder head must be broken.

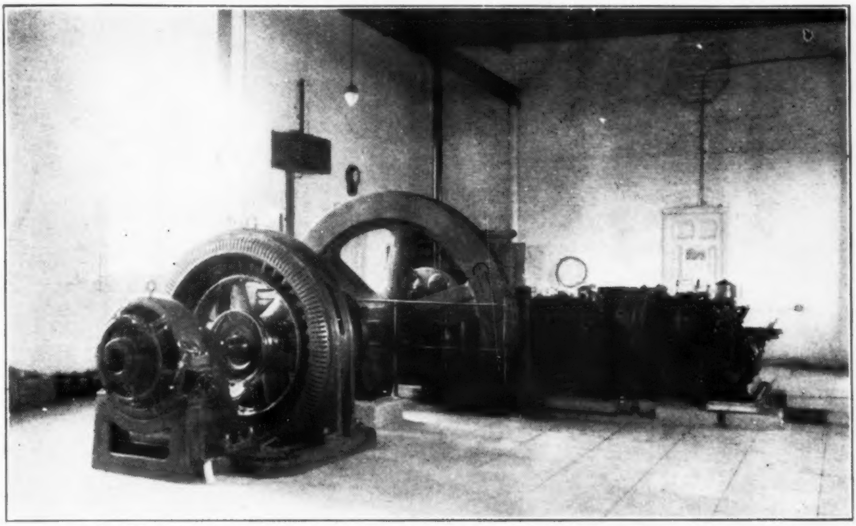
2—The valve gear, attached to the head, must be taken off.

3—The head must be removed, destroying the joint between it and the frame.

4—The piston must be blocked up and the connecting rod detached at the crankpin end.

5—The piston and rod must be drawn out through the top of the cylinder.

In replacing the piston, all these operations must be gone through in the reverse order. Head room above the engine equal to the length of the piston and rod must

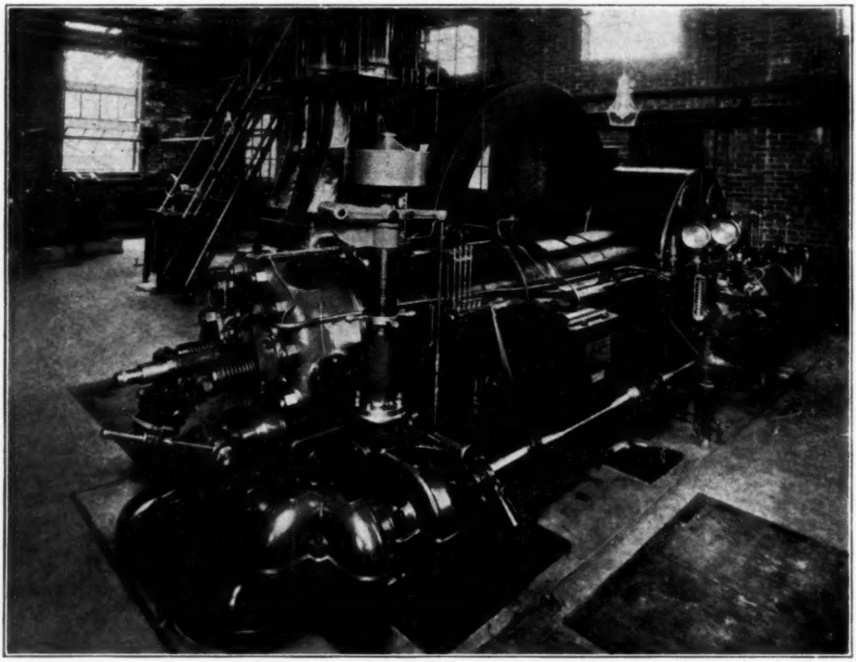


250 H. P. Direct Connection to 60-Cycle Generator Using Texaco Ursa Oil

be provided. It is interesting to note that for removing and cleaning the piston of these vertical engines about ten hours is required. The same operation has often been performed on a Snow engine in less than one hour.

The highly important question of lubrication has been given careful attention by the engineers of the Snow Steam Pump Works, and so thoroughly have the details been covered that an explanation of the lubricating system will conveniently follow a description of the engine itself. For the cylinders, injection air compressor, and inlet and exhaust valve stems a Richardson-Phenix force feed pump is used. With this system the delivery of the oil can be accurately timed and each drop can be placed on the spot intended at exactly the moment when it will be most effective. The main and outboard bearings, crosshead-shoe, wristpin, crankpin, and all gears are lubricated by a gravity feed system and filter. Cam-roller bushings are lubricated with grease cups. Camshaft and layshaft bearings are supplied with oil rings.

The crosshead mentioned above, and distinctive with the Snow design, greatly facilitates the lubrication of the cylinder, as it relieves the cylinder walls from the thrust of the connecting rod. The weight of the piston causes approximately one-fifth the pressure on these walls found in engines of the trunk design. The crosshead, removed from the heat of combustion, can be much more easily and economically lubricated. When the wristpin is placed in the piston it is not only inaccesible to lubrication and adjustment, but is subjected to a high temperature. The crosshead has other advantages, such as overcoming the tendency of the cylinder to wear elliptical, and not least in the list, the fact that the piston can be made a loose fit. The trunk piston, which acts as a crosshead, can have little clearance, or it will



65 H. P. Snow Engine Belted to a Deep Well Pump

knock with each power stroke. This lack of clearance causes a tendency to seize, due to expansion, and perhaps crack both piston and cylinder liner.

The main bearings on the single cylinder engines are made in three pieces, the portion away from the cylinder being adjusted by a wedge to take care of any wear. One bearing on multiple cylinder engines is made adjustable vertically as well, so that perfect alignment can be maintained. All outboard bearings are of the ball and socket type, and rest on a wedge, by means of which they can be raised or lowered. Sight feeds are supplied in each case so that any tendency of the oil to stop flowing can be instantly noted.

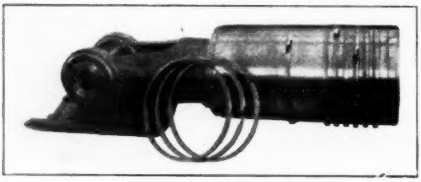
The layshaft, with gears, and the governor, are supported by brackets on the frame. The governor runs in oil. A continuous bath from the gravity system lubricates the helical gears by which the layshaft is driven. The camshaft drive is by bevel gears. The fuel pump is attached to the governor bracket, and regulation is obtained by limiting the suction stroke by means of a wedge. Thus, when the load decreases the governor rises, carrying the wedge with it. When the spring tends to force the fuel pump plunger out on the suction stroke the distance it can travel is limited by this wedge, and only the correct amount of oil is drawn into the fuel pump cylinder and forced into the spray valve on the discharge stroke. This pump, as will be explained later, works against only four or five pounds pressure, and a very simple packing

is all that is required. The supply of fuel for the pump is stored in a water jacketed tank mounted on the engine. When heavy crude oils are used the warm, cooling water can be passed through this jacket, raising the temperature of the oil to such an extent that it can be easily handled by the pump.

The cylinder head is a very simple steel casting, with spray valve in the center and exhaust and inlet valve on either side. The air starting valve, for which low pressure air of about 150 pounds only is required, is placed beneath the spray valve. The cylinder head is attached to the frame by studs, extending all the way through, and two of these studs support the fulcrum shaft. The rocker arms for the inlet and exhaust valves are mounted concentrically on this shaft, but the bushings for the fuel and air starting valves are slightly eccentric.

In starting, the fulcrum shaft is turned through an angle by a lever mounted thereon. A quadrant, with marked notches, shows the proper position. This operates the eccentrically mounted spray and air starting valve levers, throwing the former away from and the latter against its cam. In addition to this, the exhaust valve cam has an extension on one side, so that by shifting the roller sidewise, and so that it will be acted on by this extension, the valve will open one stroke during each revolution instead of one stroke during every two revolutions, as under normal operating conditions. In other words, the normal cycle will consist of a power stroke, an exhaust stroke, a suction stroke and a compression stroke. In starting, the exhaust valve is held open during the usual compression stroke, so that the order of events will be (1) admission of air, (2) exhaust, (3) idle, (4) idle, (1) admission of air, etc. This shift, however, is accomplished by the same movement of the lever as is required to put the air starting valve fulcrum in position, no extra operation being necessary. After the engine has made several revolutions on air the operating lever is thrown in the "operating" slot, which throws the air starting valve *out*, and the spray valve *in* position, as well as allowing the exhaust valve roller to return to normal position. The oil being sprayed into the hot compressed air, the engine will at once operate on its own power. Normal speed is reached in a few seconds and the load can be thrown on. The entire starting operation does not require more than one minute from cold engine to full load.

All valves are placed in cages so that their removal and replacement with a spare is only a matter of a few minutes. The opening formed when a valve is taken out can be used to inspect the inside of the cylinder. The exhaust valve casing, and in the larger sizes the valve itself, is water cooled. The spray valve is of the "open" type, which means that the fuel coming from the governor pump is deposited in a chamber shut off from the cylinder proper only by a tortuous passage known as the atomizer. The oil being pumped in on the suction stroke, only a few pounds pressure must be overcome by the pump. When the spray valve opens, air under about 800 pounds pressure is admitted to the chamber containing the oil, which it picks up and forces through the atomizer. Here it is broken up into minute particles, and finally delivered into the cylinder, where



Piston and Crosshead

complete combustion ensues. Only the air passes the needle valve seat. Engines using the "closed" nozzle construction must pump the oil against a pressure of 800 pounds or more into a recess containing the high pressure air, and when the needle valve opens both air and oil blow past the seat and into the cylinder. Thus this seat is not only subjected to cutting through impurities in the oil, but to fouling and sticking when oils of high asphalt content are used.

To supply the air for injecting the fuel a simple multi-stage compressor is used. For a few of the smaller size single cylinder Snow engines a two-stage compressor is sufficient, but on larger sizes and all twin cylinder engines the compressor is built in three stages. This keeps down the temperature of compression and greatly simplifies the process of lubrication. The compressor is bolted to the frame and is driven by an overhung crank on the end of the main shaft, the pin being lubricated by the gravity system through a sight feed. Some builders of horizontal engines drive the compressor with an eccentric, a difficult device to lubricate, besides being less efficient mechanically.

Oil engines are applicable to all power purposes where they can be operated more economically than the existing prime mover. They can be arranged for belt drive or direct connection to pumps, air and ammonia compressors, alternating and direct current generators, etc. When connected to pumps or ice machines, it is customary to extend the shaft beyond the outboard bearing and use a flexible coupling. Side crank air compressors may have their crank disc fitted on the oil engine shaft, the outboard bearing being eliminated. Generators are mounted directly on the engine shaft between the flywheel and outboard bearing.

From actual tests, about 18 horse-power hours are obtained from one gallon of fuel when the engine is running at full load. The increased consumption at fractional loads is small, results showing the figures to be approximately 16 and 13 horse-power hours per gallon at one-half and one-quarter loads respectively.

In spite of the fact that the heaviest and costliest parts of an oil engine, such as the frame, are subjected to practically no deterioration, it is usually, and somewhat unjustly, assumed that the life of the engine is about ten years. A little thought will show the fallacy of this reasoning. Engines of this type, however, with their wonderful fuel economy, and in spite of this unjust handicap which has been placed upon them, can still show an extremely attractive saving in power cost in practically every instance.

The lubrication factor is an extremely important one in oil engine operation. As can be seen from the above description, the Snow engine has been so designed that there will be no doubt in regard to the oil reaching every vital spot. But care must also be taken to see that the proper oils—lubricants which have been proved efficient for this class of work—are used.

COLD TEST AS APPLIED TO LUBRICATING OILS

All lubricating oils display the general characteristics of increasing in viscosity as the temperature is lower and becoming sluggish in their movement. A point is reached with any lubricating oil where the oil becomes sufficiently solidified to prevent any flow. This characteristic must necessarily be taken into account under some conditions of work where the temperatures vary considerably, and particularly where the machinery is exposed to atmospheric temperatures at all times in a climate which includes a considerable period of low temperature. Most of the operations of machinery are conducted in buildings sufficiently protected from the cold as to make the question of viscosity at low temperatures one of little importance. Under these normal conditions so long as the lubricating oil possesses the right characteristics and the proper viscosity for the working temperature, the changes which occur at lower temperature may be disregarded for all practical purposes. The exceptions to this rule, however, are sufficiently numerous and involve lubricating operations of a sufficiently important character to make the cold test a matter of consideration, and one which should be thoroughly understood.

There is a difference between the action of lubricating oils manufactured from paraffine base crude and that of other oils; this action arising from the fact that in practically all cases the oils of the former type contain a certain amount of paraffine wax which has not been entirely eliminated in the process of manufacture. The extent to which the wax is removed governs the temperature at which the oil will solidify. For those special purposes, however, where the lubricating oil must remain fluid at low temperatures there is an increased difficulty in the removal of the paraffine wax so that the required fluidity will be secured. In the testing of oils to determine the increase of viscosity on account of lowering of temperature, and the point at which the oil becomes too solid to flow, the required apparatus consists of a pan filled with ice or a freezing mixture, surrounding a cylinder in which the oil is placed. A cold test thermometer is placed in the cylinder passing through the cork so that top of thermometer bulb is just below the surface of the oil being tested. As the temperature decreases the cylinder is taken out of the bath at every 5° mark and tipped slightly. If the oil flows it is put back and the experiment repeated until it refuses to move when the cylinder has been tipped to an angle of 90°. The cold test temperature is determined by the previous reading from the one at which this condition is observed.

It is customary in connection with oils containing paraffine to take the temperature at which the oil becomes cloudy from the partial separation of the wax. This test is called the "cloud test."

Lubricating oils to be used in connection with ice machines, in automobiles where the winter climate is cold, in machinery exposed to the atmospheric temperature during cold weather, and in special conditions of various kinds, must have a low cold test. Oils which do not contain paraffine wax,

such as Texaco Motor Oils, have a naturally low cold test and these oils are particularly valuable for the special conditions referred to. The cold test can be carried to the zero point on these oils without showing complete solidification,and in many cases a still lower temperature can be reached. For ice machines and other conditions where the temperature remains low under working conditions, it is obvious that there can be no lubricating efficiency unless the oil is of the correct viscosity at such temperatures. In the case of automobiles, the advantage of the low cold test lubricating oil lies rather in the fact that there is no intervening period in starting the motor during which the lubricating will be ineffective while the temperature has not reached its normal working point.

As is the case with the other test, the cold test does not illustrate anything in regard to the suitability of the oil except in respect of its ability to meet certain required conditions of temperature. Under those conditions it is a valuable advantage of very measurable quantity in the reduction of friction and in the working of the unit. It is in those cases one of the characteristics which should be required of an oil. In all the other general conditions of lubricating it is not of importance to the user.

The manufacturer of lubricating oil for which very low temperature fluidity is desirable, must of necessity take into account the other conditions of pressure, speed, etc., under which the lubricating oil will be required to work, so that it will be able to meet all these conditions to the best advantage from the standpoint of use. The mere fact that an oil has a low cold test even under conditions requiring such a cold test, does not demonstrate its value, and it will require the operation of the oil in service to indicate the way in which it measures up to the other conditions.

It is for this reason that the study of lubricating requirements which has governed the manufacture of Texaco Lubricating Oil has led to the conclusion at all times that such tests, while they are indicative of certain values, cannot in any way replace the practical test in daily use, which will indicate the comparative efficiency from the standpoint of reducing consumption, wear and tear, etc. Where an oil is required to work under low temperatures, it must be able to meet the temperature conditions and under such circumstances the cold test is of importance. This fact itself, however, will be demonstrated in a practical test of the oil, as well as the other facts which are required to estimate its ultimate value. In this respect, as in others, The Texas Company is fortunate in having available, supplies of the different kinds of crude oil so that in the development of its lubricating oils for the conditions under which they will be used, it is able to select these oils from the crude which possesses the characteristics required. These values are further enhanced by the methods of manufacture which are directed entirely to the development of oils suited to the requirements of their work and capable of performing their duties with the maximum of efficiency.